Effects of Elderly Priming on Driving Speeds:

A Driving Simulator Study

by

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ABSTRACT

Research on priming has shown that a stimulus can cause people to behave according to the stereotype held about the stimulus. Two experiments were conducted in which the effects of elderly priming were tested by use of a driving simulator. In both experiments, participants drove through a simulated world guided by either an elderly or a younger female voice. The voices told the participants where to make each of six turns. Both experiments yielded slower driving speeds in the elderly voice condition. The effect was universal regardless of implicit and explicit attitudes towards elderly people.

DEDICATION

To my beautiful wife Chelsea. Words cannot describe my gratitude for your support. Thank you for helping me obtain my goals and providing balance in my life.

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TABLE OF CONTENTS

APPENDIX Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Introduction

Most people know what it means to act consciously. Conscious acts are those we are aware of, that we intend, that require effort, and that we can stop or control once initiated (Logan & Cowan, 1984). Likewise, most understand what it means for something to be automatic. It is something that happens as long as certain conditions are met. Thus, a car's automatic transmission shifts once the revolutions per minute exceed a threshold. This unburdens the driver to think about other things, like locating a restaurant.

One type of human automaticity is demonstrated in skilled behavior. An intentional skill, such as riding a bicycle, is considered automatic when it becomes efficient with practice. As a result, such skills can be conducted with little effort or conscious guidance (Anderson, 1983). It is important that such activities become automatic, because conscious awareness, intention, effort and control are cognitively expensive. For example, Baumeister and his colleagues revealed how cognitively expensive conscious choice is (Baumeister, Bratslavsky, Muraven & Tice, 1998; Muraven, Tice & Baumeister, 1998). In their experiments, exercising self-control (being told not to eat chocolate chip cookies in front of you) diminished a person's self-control in subsequent, unrelated verbal tasks. This demonstrates that even minor acts of self-control expend limited resources. Such acts of self-control can occur only rarely throughout the day. Automatic processes, on the other hand require less effort, control and awareness, liberating cognitive resources for other activities.

The theory of automaticity in behavior extends from seminal research in priming by Neely (1997) and Meyer and Schvaneveldt (1971). The latter made use of reaction time tests to show that exposure to a stimulus affected the response time to subsequent stimuli. They had participants perform a lexical decision task in which the participant must decide as quickly as possible whether a string of letters formed an English word. Response to the target word was quicker if it was preceded by a closely related word than with unrelated control words.

Automatic Perception

There is another set of mental activities, called automatic perception, with which people are less familiar. These processes encode stimuli in our surrounding environment, and ensue without effort, intention, control, or awareness. Consider vision as an example. If our eyes are open, we cannot avoid perceiving stimuli in the environment. Our eyes are constantly on the move in a series of saccades and fixations over which we have little control. This visual perception requires no effort, we cannot really control our eye movements, and we are not generally aware everything we see (Simons & Chabris, 1999; Simons, Franconeri & Reimer, 2000).

William James (James, 1890) promoted the notion of ideomotor action to explain how simply thinking about an action, even in the absence of volition, increases its likelihood. His summary of the idea was that “thinking is for doing”. Extending this notion Bargh and Chartrand (1999) proposed that, “perceiving is for doing”. That is, just perceiving an action increases the likelihood that the perceiver will perform that action. They argue that, “automatic perception induces the ideas". Perception automatically activates internal representations of the world. These representations include present objects, events, behavior of others, and so on. In this way automatic perception of the environment introduces the idea of action. Perception provides a direct and automatic path from the environment to action.

Automaticity in social behavior

Research on automaticity in social behavior has taken what has been learned about priming a step further. It has been shown that automaticity exists not only in routine tasks, but also in activities like social interaction and goal pursuit. Bargh, Chen and Burrows (1996) conducted experiments in which behavior was altered by the presentation of certain traits. For example, participants primed with a concept of rudeness interrupted the experimenter more quickly and frequently than those primed with a polite concept. In a subsequent experiment, they primed one group of subjects with an elderly stereotype. The prime was induced using a scrambled sentences task with words like Florida, grey, bingo, etc. The other group was given a neutral scrambled sentences task containing words like thirsty, private, and clean. After completing the sentence scramble task, participants left the room and walked down a hall toward the elevator. The experimenters recorded how long it took them to reach the elevator, and found that elderly primed participants walked slower than those who received the neutral prime. Epley and Gilovich (1999) found similar results when they primed participants for conformity or nonconformity using a scrambled sentences task similar to Bargh et al. (1996). Participants in the conformity group expressed views that that were more similar to those of experimental confederates than did the participants primed with nonconformity (Meyer, 2004; Bargh et al., 1996; Epley & Gilovich, 1999; Bargh & Chartrand, 1999).

It was originally believed that behavior was a conscious effort. Of course we all believe that we are making all the decisions about our behavior. However, accruing evidence suggests that these automatic perceptions of the environment, perceptions of which we are unaware and over which we have no control, affect most of our everyday life (Bargh & Chartrand 1999). This is not to suggest that we have no conscious control over our lives. Instead, it suggests that our thinking and behavior are determined by factors in the environment, as well as by acts of volition (Chaiken, Duckworth & Darke, 1999). A model of how perception and/or thought lead to behavior is set forth by Dijksterhuis, Chartrand and Aarts (2007; *Figure* 1). They theorize that there are potentially three routes that lead to behavior. One route is a conscious while the other two routes are unconscious. The conscious route is goal driven and is the traditional way of understanding behavior. The goal route consists of paths 5, 6 and 7. The two unconscious routes are the mimicry route and the trait route. The mimicry route consists of paths 1, 2, and 7. Chartrand and Bargh (1999) studied the mimicry route and found that people unconsciously mimic others. In one experiment, a confederate would rub his nose or tap his foot. Participants mimicked the action of the confederate without conscious awareness. The trait route consists of paths 3, 4, and 7. As was shown by Bargh et al. (1999), people are likely to match the traits with which they are primed. For example, presenting an elderly prime leads them to match the traits of elderly people in their own behavior. This research hopes to further understanding of unconscious behavior as it pertains to traits.

Passenger effects on driving behavior

Driving provides an ideal environment for testing the effects of behavior primed by traits. Once learned, driving becomes an automatic task. The effects of unconscious traits can be measured by speed and general driving behavior. A few studies have looked at the effects of passengers on driving behavior. Through a field study, Simons-Morton, Lerner and Singer (2005) analyzed the behavior of drivers exiting from ten high school parking lots. They paid special attention to the gender of both the drivers and passengers. Risky driving behavior was measured by the speed of the vehicle and headway given to passing traffic. Not surprisingly, they found that teenage drivers drove faster than the general traffic. They also found that the risky driving behavior was more common when a male passenger was in the vehicle. Chen, Baker, Braver and Li (2000) used data from traffic accidents, involving teenagers, to show that teenage drivers are at greater risk of fatal collisions when carrying teenage passengers. Conversely, a similar study conducted by Vollrath, Meilinger and Krüger (2001) found that collisions were less likely when a passenger was present. They suggest that the passengers may exert a protective influence on drivers causing them to drive more safely. Although these studies provide different results, they do suggest that passengers are affecting the behavior of the driver. The notion that the presence of passengers has an effect on driving behavior suggests that the driver is aware of this change. However, it is not likely that the driver is aware that he is driving differently than he would if the passenger were not there. Therefore, automatic perception seems to be leading to this change in behavior outside the control of the driver.

Elderly priming effects on driving behavior

The current research seeks to add to the findings of studies by Branaghan and Gray (2010) and Taylor (2010) regarding elderly priming effects on driving behavior. Branaghan and Gray (2010) presented a scrambled-sentence task to participants driving in a simulator. Similar to Bargh et al. (1996), the sentences had either a neutral or an elderly connotation. The data showed that participants who received the elderly sentences drove slower as evidenced by their final driving time, maximum speed between the last five stops and mean final velocity. In an attempt present the stimuli in a method common to real-world driving, Taylor (2010) presented turn-by-turn directions to participants in the driving simulator. The directions were given by either a young female or an elderly female. Maximum velocity was measured before the last turn. Similar to Branaghan and Gray, participants' maximum speeds were slower when the directions were presented by the elderly voice (Branaghan & Gray 2010; Taylor, 2010).

The effects of priming are not seen immediately. Branaghan and Gray (2010) noticed that there was an activation time of about five stops before the effects of the prime were significant. Priming also shows the ability to have a continued effect on the individual for as long as 15 minutes after the presentation of the stimulus. These findings were taken into account in the design of the current experiments. As was done by Taylor (2010), speed was measured at the end of the simulations to allow for the priming to take effect.

Method

Experiment 1

Experimental design

To test the effects of age stereotyping on behavior, we followed the model set forth by Taylor (2010). Taylor incorporated the use of a driving simulator to examine driving behaviors for two separate conditions. Each participant drove through a virtual city with the assistance of a voice navigation system. Two voices were used for the directions, an elderly female voice and a young female voice. Taylor found that participants drove significantly slower when they were guided by the elderly voice. The effect was especially strong when there was no speed feedback given. Taylor recognized that her model was limited as there were only two voices given to participants. The current research used six female voices in all (3 young and 3 old) to validate the results found by Taylor. The young in-car navigation voices were female aged 19-21. The old in-car navigation voices were female aged 72-75. To control for order effects, conditions were counterbalanced across participants. Changes were also made to the simulated environment. In Taylor (2010) ambient traffic, programmed to drive the speed limit of 30 mph, was present. To increase speed variability, this ambient traffic was removed from the simulations.

Participants

Twenty-seven drivers, 17 male and 10 female, were recruited from the Psychology subject pool at the Arizona State University Polytechnic Campus. All drivers had normal (20/20) or corrected to normal vision. Each session took approximately one hour for each participant.

Apparatus

Driving simulator. The fixed-base driving simulator was composed of two main components: (a) a steering wheel mounted on a table top and pedals (Wingman Formula Force GP, Logitech™) and (b) three 19” Dell™ LCD monitors. The monitors were viewed from a distance of 57cm. The three monitors were positioned side-by-side to create a driving scene that subtended a total of 130° H x 30° V of visual angle. The visual scene was rendered and updated by DriveSafety™ driving simulator software running on four PC’s (Dell Optiplex GX270) and updated at a rate of 60 Hz. The DriveSafety™ software captured various driving performance elements at 60 Hz. This system was used for all three experiments to ensure consistency.

Procedure

Participants signed an informed consent and then were given the task instructions. Participants navigated through a virtual city in a driving simulator. The city consisted of 4-lane roads with signaled intersections. The surrounding environment (e.g. buildings, etc.) was similar for each intersection so as to provide no ‘landmark’ cues to the location in the virtual city. Each intersection was marked with a within-intersection road sign. No speed feedback was given to any drivers. Drivers were instructed to drive at a speed at which they were comfortable. They were asked to obey all traffic signals and laws. The posted speed limit in the simulations was 30 mph. All other ambient traffic was removed from the simulations. This was done to ensure drivers did not maintain similar speeds as other cars. The route was indicated by an auditory in-car navigation system. Each route consisted of six turns. Participants were given a short break after each driving run to allow the experimenter to load the next scenario.

Four different tracks were created, each consisting of six designated turns. Pre-recorded auditory messages were given to drivers such as, “Next turn: Left on Washington Street”. There were six unique voices giving the directions, three elderly women aged 72-75 and three young women, aged 19-21. Drivers received one prompt for each turn. Each participant completed drove all four of the tracks and received directions from four of the six voices. All participants received directions by two unique elderly and two unique young voices. The voice conditions were counterbalanced across participants so each voice was represented equally in each position. The voice age conditions were not presented in blocks. For an example of the counterbalance scheme, see (*table 1).* After the completion of the four driving scenarios, participants completed a debriefing questionnaire.

It was predicted that average maximum driving speed, would be lower for drivers receiving elderly recordings as compared to younger recordings as shown by Branaghan and Gray (2010) and Taylor (2010). Because the use of a speedometer served to minimize variance in driving speeds, it was left out for this experiment. Each session took approximately one hour.

Results

The dependent variable was the maximum speed reached between the penultimate and final turn on each driving run. Testing the speed at the end of the simulation would allow for the prime to take effect. These speeds were then averaged across the two conditions to obtain an average maximum speed for each condition.

A paired-samples t-test shows a significant difference between the speeds in the old and young conditions, $t(26) = 6.11$, $p = .00$ (*Figure 3*). This result is consistent with my hypothesis and with Taylor's, that an elderly voice yields slower driving than a young voice.

There was no difference between male and female driving speeds as shown through a repeated measures ANOVA with voice age as the within subjects factor and gender as the between subjects factor.

A mixed model ANOVA with voice age condition as the within subjects variable revealed that voices within the age condition did not affect driving speed. I also analyzed the voice recordings to see if there was a difference in speed of delivery between the old and young voices. Utterances were measured from the onset to completion in seconds. An independent samples t-test revealed no significant difference between the segment length between old and young voices.

Through the debriefing questionnaire, 62% of participants believed they maintained a consistent speed throughout the four simulations. There were two main explanations cited by those who believed their speed changed. Some stated that they needed to slow down dramatically to read the street signs. Others believed that they increased their speed as they became more comfortable with the simulator.

Discussion

The results of this experiment further verify the slowing effect caused by an elderly prime (Bargh et al., 1996; Branaghan & Gray, 2010; Taylor, 2010). By adding more voices to the model we reduced the concern that previous effects may have been caused by specific characteristics in the voices used. Also, the removal of ambient traffic on the road eliminated an element by which drivers could gauge their speed. When participants received directions from a young voice, their maximum speed was 2.2 m/s faster than when directions were given by an old voice.

The use of the driving simulator is intended to test the effects of priming in a realistic environment. However, some elements that add to the realism can act as confounds to the results. For example, ambient traffic was removed so drivers did not match the speed to other cars. This makes the simulation less realistic, but allows further isolation of the voice age variable. Even still, there were a few elements present that may have altered driving speeds. First, the existence of speed limit signs may have affected the speed of participants. Although they received no speed feedback, and were not expressly told to obey the speed limit, they may have attempted to maintain a speed that matched the posted speed limit. Secondly, use of stoplights at intersections added variability. Finally, intersections between turns caused some participants to change speed to read the street signs. The removal of these items would help to isolate the voice age variable.

Experiment 2

Experimental design

The second experiment was designed to further validate the effects of the voice age on driving speeds, and minimize external factors that may affect speed. Changes were made to the conditions to address these potential issues and isolate the voice age variable as much as possible. The landscape was changed from a 4-lane city road to a rural two-lane road and all speed limit signage was completely removed. Stoplights in the previous design were variable and may have altered a participant's speed. To help ensure consistency, stop signs were used instead of stoplights. It was also noticed that intersections between target turns were causing participants to slow down to read the street signs. To eliminate the need to slow down to verify the name of the street, intermediary intersections were removed. Participants made turns at a "T" in the road. This meant they did not need to verify they were turning on the correct street. Furthermore, the distance between turns was held constant. These changes should help to isolate the voice age variable and remove some of the variability introduced by the environment.

Implicit Association Test (IAT)

The Implicit Association Test (IAT) provides a measure of strengths of automatic associations. This measure is computed from performance speeds at two classification tasks in which association strengths influence performance. The IAT effect is based on latencies for two tasks that differ in instructions for using two response keys to classify four categories of stimuli. Simply put, participants are shown an attribute and asked to assign it to a target. Reaction times for blocks with compatible targets and attributes are compared to reaction times of incompatible blocks. An example of attributes could be good or bad, with targets of flowers or insects. Most people automatically associate flowers with good and insects with bad. It would be expected that quicker reaction times would be seen when good and flower are together than good and insect, based on implicit association of the targets and attributes. Reaction times for the blocks are analyzed to obtain an effect size measure (**d**=M/SD). Conventional small, medium, and large values of **d** are .2, .5, and .8 respectively. (*Table 2)* shows the algorithm for computing IAT effect size.

After completing the driving portion of the experiment, participants completed an Implicit Association Test (IAT) designed to provide a measure of strength of automatic associations between elderly people and slow attributes (*Table 3*). Blocks were presented with pictures of elderly and young faces. The pictures showed only the eyes of the person to help ensure that other features were not creating bias. Attributes were presented in the form of descriptive synonyms for slow or fast. It is predicted that participants will have quicker reaction times when targets and attributes are compatible (old and slow)(*Figures 4&5)*.

After the IAT, explicit bias toward a certain age group was determined using a 10-point scale. Participants were asked how warm they felt towards elderly people and young people. Zero on the scale represented the coldest and ten represented the warmest feelings. The IAT and explicit bias results were used to determine if people who held a stronger stereotype toward elderly people were more influenced by elderly voices.

Participants

Thirty-six drivers, 27 male and 9 female (*M*=19.6, *SD*=2.4), were recruited from the Psychology subject pool at the Arizona State University Polytechnic Campus. All drivers had normal (20/20) or corrected to normal vision. Each session took approximately one hour for each participant.

Apparatus

In addition to the driving simulator, participants used a 20-inch Apple iMac to complete the IAT, explicit (self-report) test and demographics questions. The IAT was developed and administered using Inquisit 4.0 by Millisecond Software.

Procedure

The procedure for the driving simulations remained relatively the same as in Experiment 1. Each participant completed four tracks with two voices from each age condition providing directions. A change was made to the order in which the voices were presented. In Experiment 1, the voice age conditions were not presented in blocks. For this second experiment, the voices conditions were given in blocks. In other words, the participant always received two elderly voices together and two younger voices together. This was counterbalanced so each voice was equally represented in each position (*Table 4).* After completion of the driving portion, participants moved over to another computer to complete the

IAT, explicit and demographics portions of the experiment. The total time to complete the entire experiment was approximately 30 minutes.

As with the previous experiments, it was predicted that average maximum driving speed, would be slower for drivers receiving elderly recordings as compared to younger recordings. It was also predicted that participants who more strongly associated slow with elderly people, implicitly or explicitly, would drive slower than those who did not.

After the completion of the four driving scenarios, participants completed a debrief questionnaire with questions regarding how many voices they heard and whether or not their speed remained consistent throughout. An example of the debriefing questions can be found in (*Appendix D*).

Results

In an attempt to obtain a better measurement of driving speed, the dependent variable was changed from the first experiment. Previously, I analyzed the maximum speed reached by the participant going into the last turn for each scenario. In this second experiment, I measured the mean speed of the participants between the penultimate and final turns. It was believed that variability would be greatly reduced by measuring the mean speed rather than the maximum speed. Furthermore, scenarios were completed in blocks, meaning that the voice age condition was given twice before moving to the next condition. As has been previously discussed, priming effects can take a few minutes to set in and last for few minutes after the stimulus. In the first experiment, voice conditions were randomized. Presenting the stimuli in blocks, and measuring the mean speed at the end of the second simulation of each block should help to eliminate carryover effects of the previous stimulus.

As has been previously observed, and consistent with the hypothesis, participants drove significantly slower when primed with an elderly voice $t(35) = 4.14$, $p = .00$ (*Figure 6)*. It had also been hypothesized that implicit and explicit biases linking elderly people would predict a greater age effect shown by driving speed. However, regressing d' and explicit attitudes onto the difference of young and old speeds showed no significant effect. That is, neither d' nor explicit attitudes acted to speed up or slow down driving.

Explicit bias scores were collected on a 10-pont scale. An average difference score was calculated for all participants at 0.4 with a standard deviation of 2.8. These scores suggest great variability in the individual scores, but no preference for one group over the other.

Discussion

The objective of this second experiment was to isolate the voice age variable as much as possible. Admittedly, the simulations are less realistic in an attempt to further validate the priming effect of the voices. Removing the speed limit signs and intersections ensures a more consistent experience for each of the participants. There was a concern that the prime would not have time to take effect since each simulation was dramatically shorter than previously tested. The total driving time for the four simulations in this second experiment was about 15 minutes as opposed to 45 minutes in the previous test. To account for the shorter time, the simulations were given in blocks and the speed was taken before the last turn in the second simulation for each voice condition. Speeds in the young condition were 1.6 mph faster than in the elderly condition. It was believed that there would be a link between implicit beliefs of elderly and driving behavior. However, it is likely that the IAT may have been underpowered and larger sample size is needed. It may also be that link between elderly and slow attributes is so universal that there is no noticeable relationship between stereotype and speed.

General Discussion

The current research helps to further understand the effects of priming. Using old and young voices, the participants were primed similarly to Taylor (2010). As hypothesized, participants drove slower when primed by an elderly voice than a younger voice. The current research implemented all female voices because of research such as Simons-Morton, Lerner and Singer (2005) that has shown that the presence of male passengers leads to faster driving speeds. There was no effect of implicit or explicit associations of elderly people and slow attributes on driving speeds. Limitations were introduced by the desire to isolate the voice variable. By doing so, the realism of the simulations was reduced. Taking ambient traffic out of the simulations allowed priming to have a greater effect, but it was not consistent with real world driving scenarios. This research could be performed with the addition of more and varied voices. It is predicted that male voices would have a speeding effect, but research is needed to test this hypothesis. Furthermore, the use of a higher fidelity driving simulation or performing field testing in real driving situations would advance understanding of priming in real world applications.

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APPENDIX A

TABLES

Table 1. Experiment 1 counterbalance. Each participant completed all four tracks.

	Young			Elderly		
Participant #	**Young voice 1**	**Young voice 2**	**Young voice 3**	**Elderly voice 1**	**Elderly voice 2**	**Elderly voice 3**
1	Track 1	Track 4		Track 3	Track 2	
2	Track 2	Track 3			Track 4	Track 1
3	Track 3	Track 2		Track 1		Track 4
4		Track 1	Track 4	Track 2	Track 3	
5		Track 4	Track 3		Track 2	Track 1
6		Track 3	Track 2	Track 4		Track 1
7	Track 4		Track 1	Track 2	Track 3	
8	Track 1		Track 4		Track 2	Track 3
9	Track 2		Track 3	Track 1		Track 4
10	Track 3	Track 2		Track 4	Track 1	
11	Track 4	Track 1			Track 3	Track 2
12	Track 1	Track 4		Track 2		Track 3
13		Track 3	Track 2	Track 1	Track 4	
14		Track 2	Track 1		Track 4	Track 3
15		Track 1	Track 4	Track 3		Track 2
16	Track 2		Track 3	Track 4	Track 1	
17	Track 3		Track 2		Track 1	Track 4
18	Track 4		Track 1	Track 3		Track 2
19	Track 3	Track 2		Track 4	Track 1	
20	Track 4	Track 1			Track 3	Track 2
21	Track 1	Track 4		Track 2		Track 3
22		Track 3	Track 2	Track 1	Track 4	
23		Track 2	Track 1		Track 4	Track 3
24		Track 1	Track 4	Track 3		Track 2
25	Track 2		Track 3	Track 4	Track 1	
26	Track 3		Track 2		Track 1	Track 4
27	Track 1		Track 4	Track 2		Track 3

Table 2. Implicit Association Test (IAT) Scoring Algorithm

Step 1: Use data from the following blocks; B3, B4, B6 & B7
Step 2: Eliminate trials with latencies 10,000 ms; eliminate subjects for whom more than 10% of trials have latency less than 300 ms
Step 3: Compute mean of correct latencies for each block
Step 4: Compute one pooled *SD* for all trials in B3 & B6; another for B4 & B7
Step 5: Replace each error latency with block mean (computed in Step 3) + 600 ms
Step 6: Average the resulting values for each of the four blocks
Step 7: Compute two differences: B6-B3 and B7-B4
Step 8: Divide each difference by its associated pooled- trials *SD* from Step 4

Table 3. Implicit Association Test (IAT) tasks for Age Speed. Tasks 1, 2, and 4 are single-category tasks introducing target items (photographs of young and older persons). Tasks 3 and 5 are combined-category tasks that provide the critical trials for the IAT. Category poles (e.g., young, old) are assigned to a left or right response key. Participants use the designated key to indicate the category membership of items. The IAT effect is the response time (RT) to Task 5 (incongruent) trials minus the RT to Task 3 (congruent) trials. Positive IAT effect scores indicate for Age Speed, a stronger relationship between old people and fast descriptive words.

Sequence	**Task 1:** Category I Discrimination		**Task 2:** Category II Discrimination		**Task 3:** Categories I + II Incongruent Task		**Task 4:** Reversed Category I Discrimination		**Task 5:** Categories I + II Congruent Task	
Hand Assignmer	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand	Right Hand
Age Speed IAT	Old	Young	Fast	Slow	Old Fast	Young Slow	Young	Old	Young Fast	Old Slow

Table 4. Experiment 2 counterbalance. Voice age conditions presented in blocks.

	Young			Elderly		
Participant #	**Young voice 1**	**Young voice 2**	**Young voice 3**	**Elderly voice 1**	**Elderly voice 2**	**Elderly voice 3**
1	Track 1	Track 2		Track 3	Track 4	
2	Track 4	Track 3		Track 2		Track 1
3		Track 3	Track 4	Track 1	Track 2	
4		Track 1	Track 2		Track 3	Track 4
5		Track 3	Track 4	Track 1	Track 2	
6		Track 4	Track 3	Track 2		Track 1
7		Track 2	Track 1	Track 4		Track 3
8	Track 2		Track 1	Track 4	Track 3	
9	Track 2		Track 1		Track 4	Track 3
10	Track 2		Track 1	Track 4	Track 3	
11	Track 2		Track 1		Track 4	Track 3
12	Track 3	Track 4		Track 1	Track 2	
13	Track 1		Track 2	Track 3		Track 4
14	Track 2	Track 1		Track 4		Track 3
15	Track 1	Track 2			Track 3	Track 4
16	Track 4		Track 3	Track 2	Track 1	
17	Track 1		Track 2	Track 3		Track 4
18		Track 1	Track 2	Track 3	Track 4	
19		Track 1	Track 2		Track 3	Track 4
20	Track 3	Track 4			Track 1	Track 2
21		Track 3	Track 4		Track 1	Track 2
22	Track 3	Track 4		Track 1	Track 2	
23		Track 1	Track 2	Track 3	Track 4	
24	Track 4		Track 3		Track 2	Track 1
25	Track 3		Track 4	Track 1		Track 2
26	Track 4		Track 3	Track 2	Track 1	
27	Track 3		Track 4	Track 1		Track 2
28	Track 4	Track 3		Track 2		Track 1
29	Track 4		Track 3		Track 2	Track 1
30		Track 3	Track 4		Track 1	Track 2
31	Track 3	Track 4			Track 1	Track 2
32	Track 2	Track 1		Track 4		Track 3
33	Track 1	Track 2			Track 3	Track 4
34		Track 2	Track 1	Track 4		Track 3
35		Track 4	Track 3	Track 2		Track 1
36	Track 1	Track 2		Track 3	Track 4	

APPENDIX B

FIGURES

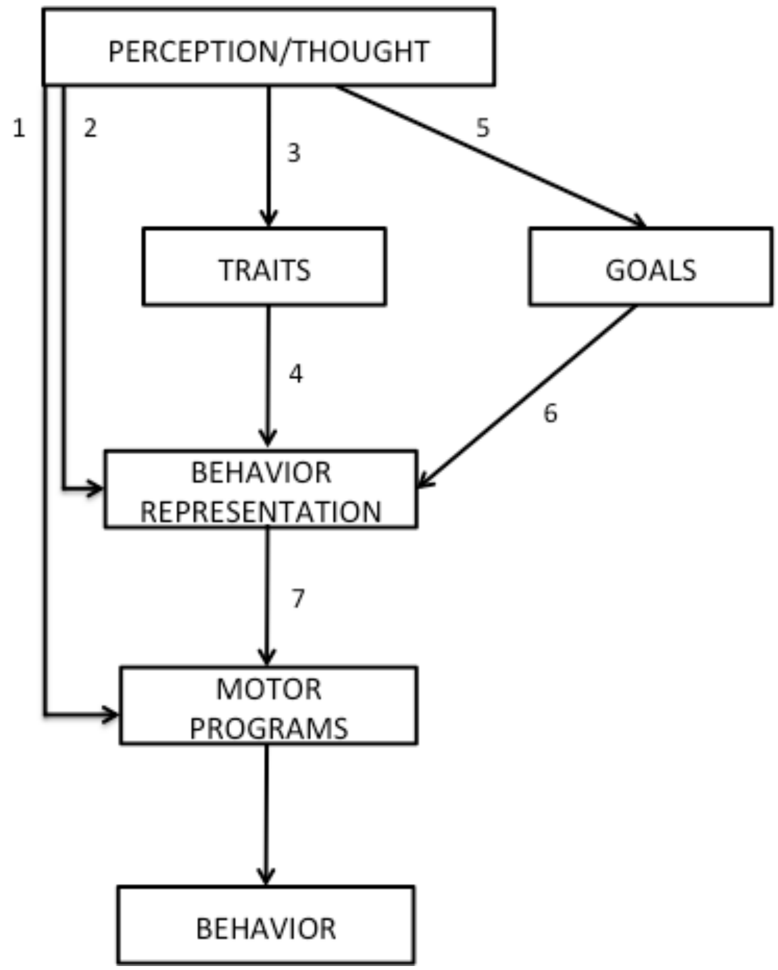

Figure 1. The building blocks of a behavior producer. Three differenent routes distiguished in the model: the mimicry route (paths 1, 2 and 7); the trait route (paths 3, 4 and 7); and the goal route (paths 5, 6 and 7).

Figure 2. Driving simulator.

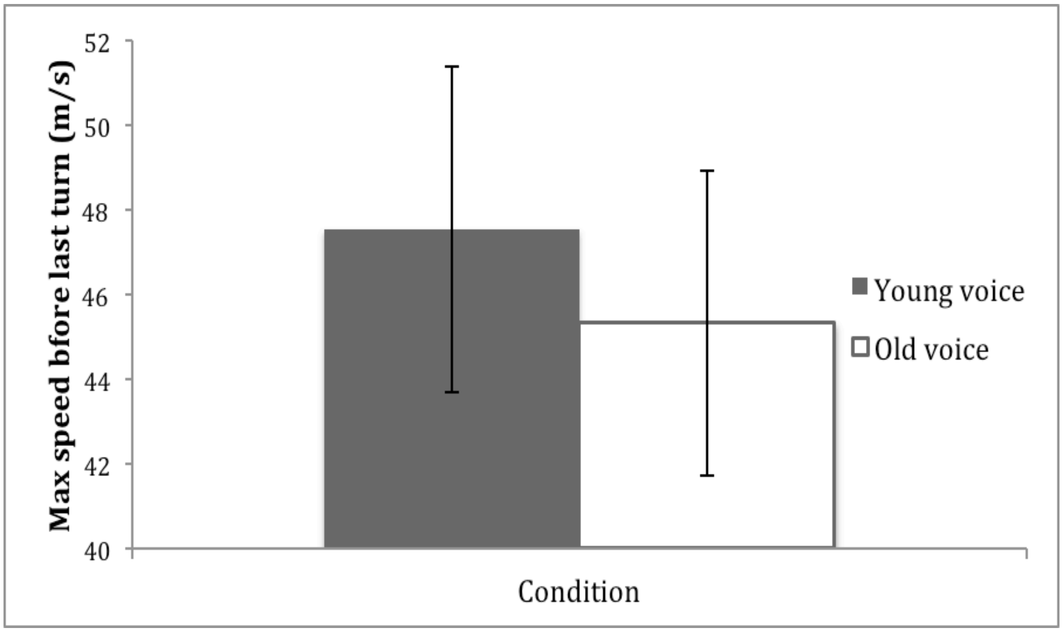

Figure 3. Experiment 1: Mean maximum speed for young and old voice age condition.

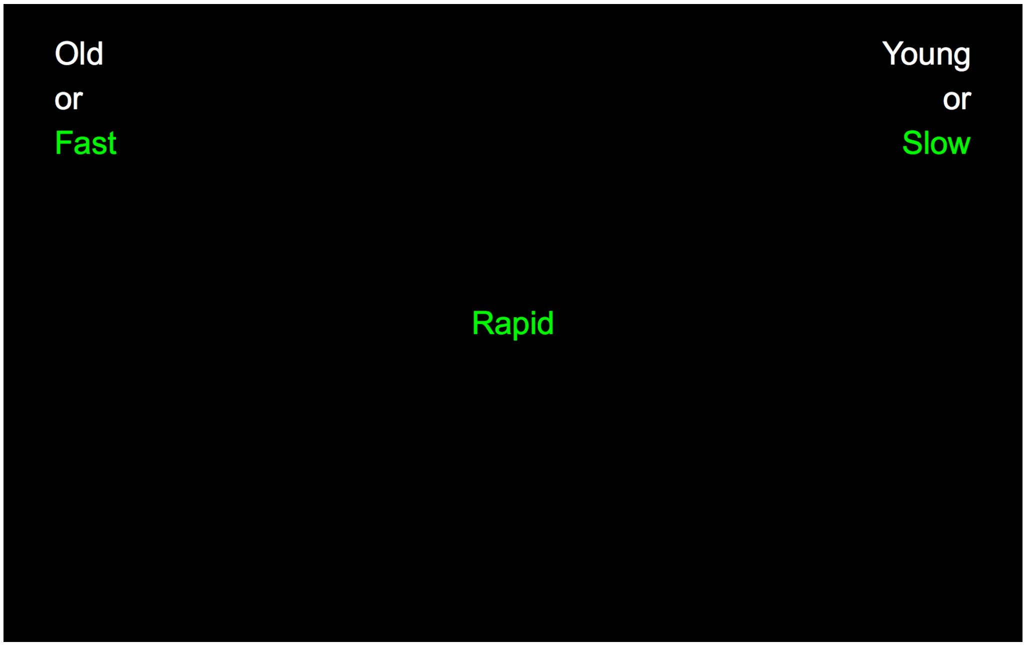

Figure 4. Screenshot of IAT with target attribute

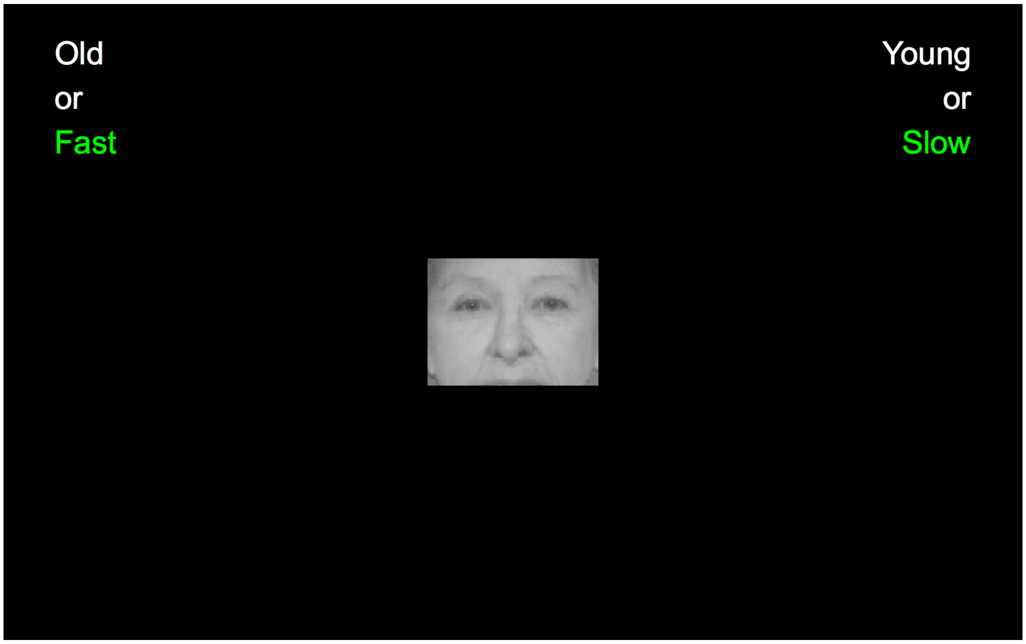

Figure 5. Screenshot of IAT with target elderly face

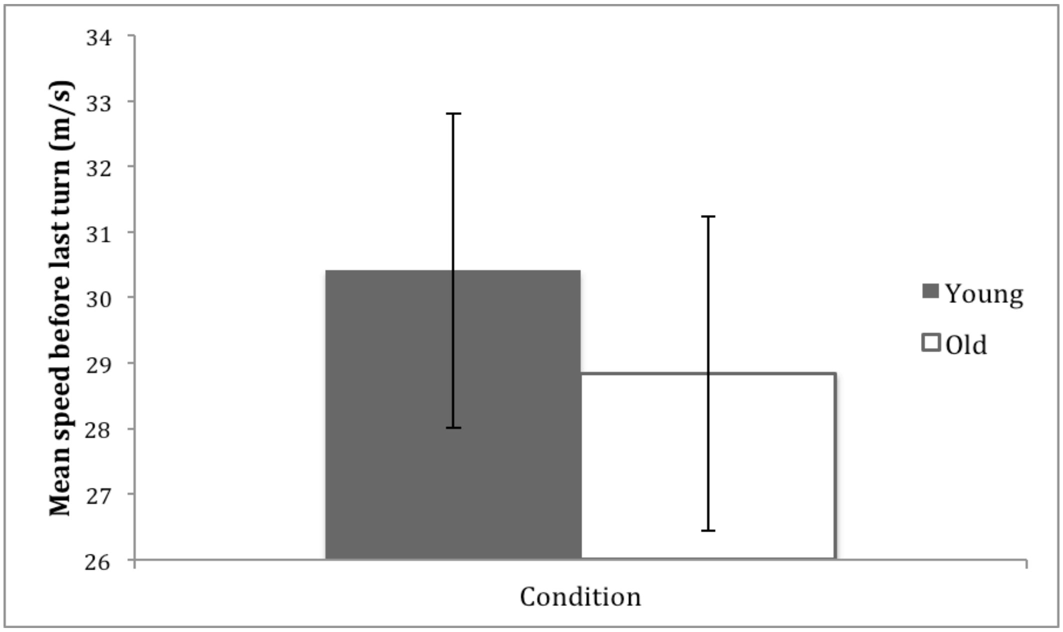

*Figure 6.*Experiment 2: Mean speed for young and old voice age conditions.

APPENDIX C

PARTICIPANT INSTRUCTIONS

Experiment 1
Participant Instructions:

In this study you will be asked to drive through a virtual city and make turns at streets designated by an audio navigation system. There will be a total of 6 turns on each drive. Specifics of the tasks are as follows:

You will receive messages through the simulator speakers indicating which turn to make next. Example, "Next turn, left on Main Street". You will only receive the message one time but you may have it repeated by the experimenter at any time by saying "repeat direction".

Please obey all traffic laws and signals.

If you miss a turn, the experimenter will guide you back on to the route.

After completing the 6 turns, keep driving and the simulation will end.

There will be a total of 4 drives. You will be given a break between each drive.

After completion of the 4th drive you will be asked to complete a questionnaire given by the experimenter.

Do you have any questions?

You can ask questions at any time during the experiment (including while you are driving) and remember you are free to take a break at any time.

Please do not disclose the details of this study to others. This will help ensure consistent and accurate results.

Thank you for your participation!

Please sign below to acknowledge receipt of these instructions.

____

Signature Date

Experiment 2
Participant Instructions:

In this study you will be asked to drive through a virtual countryside and make turns at streets designated by an audio navigation system. There will be a total of 6 turns on each drive. Specifics of the tasks are as follows:

You will receive messages through the simulator speakers indicating which turn to make next. Example, "Next turn, left on Main Street". You will only receive the message one time but you may have it repeated by the experimenter at any time by saying "repeat direction".

Please obey all traffic laws and signals.

If you miss a turn, the experimenter will guide you back on to the route.

After completing the 6 turns, keep driving and the simulation will end.

There will be a total of 4 drives.

After completion of the 4th drive you will be asked to complete a short test given by the experimenter.

Do you have any questions?

You can ask questions at any time during the experiment (including while you are driving) and remember you are free to take a break at any time.

Please do not disclose the details of this study to others. This will help ensure consistent and accurate results.

Thank you for your participation!

Please sign below to acknowledge receipt of these instructions.

Signature Date

APPENDIX D

PARTICIPANT POST SURVEYS

Experiment 1 post survey

1. Did you find the driving simulation enjoyable to use?

2. Were the directions easy to follow?

3. How many distinct voices did you encounter in the simulation?

4. Please specify the age(s) of the person(s) giving the directions.

5. Do you feel your driving behavior remained relatively the same as the experiment went on?

6. Do you feel like you maintained roughly the same speed throughout the four tracks?

Thanks again for participating in my study and please keep the details of the study to yourself.

Experiment 2 post survey

Please answer the following demographic questions

Sex

Ethnicity

Race

How many distinct voices did you encounter in the simulation?

Please specify the age(s) of the person(s) giving the directions.

Do you feel your driving behavior remained relatively the same as the experiment went on?

Please rate how warm or cold you feel toward the following groups (0 = coldest feelings, 5 = neutral, 10 = warmest feelings)

Old people

Young people

The categories child, young adult, middle-ages and old are commonly used to describe life stages. At what age do you believe that a person moves from one age category to the next?

A person moves from being a child to a young adult at what age?

A person moves from being a young adult to being an adult at what age?

A person moves from being an adult to middle-aged at what age?

A person moves from being middle-aged to being old at what age?